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REPORT

FINAL REPORT

User Guide for the Mission Degradation of Respiratory Protection Database (MDRPDB)

To

C. M. Grove and W. D. Kuhlmann

Advanced Protective Systems Integrated Laboratory,

Edgewood Research, Development

and Engineering Center

December, 1992

REPORT DOCUMENTATION PAGE

1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	DECEMBER 1992	FINAL REPORT

4. TITLE AND SUBTITLE

USER GUIDE FOR THE MISSION DEGRADATION OF RESPIRATORY PROTECTION DATABASE (MDRPDB).

5. FUNDING NUMBERS

DLA900-86-C-2045

6. AUTHOR(S)

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8. PERFORMING ORGANIZATION REPORT NUMBER

CBIAC-SS-336

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)

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EDGEWOOD AREA
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10. SPONSORING/MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES

STUDY PREPARED UNDER THE CHEMICAL/BIOLOGICAL INFORMATION ANALYSIS CENTER (CBIAC) CONTRACT WITH THE DEFENSE LOGISTICS AGENCY, TASK 336.

12a. DISTRIBUTION/AVAILABILITY STATEMENT

DISTRIBUTION UNLIMITED, APPROVED FOR PUBLIC RELEASE.

12b. DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200 words)*

A SIGNIFICANT PORTION OF THE PERFORMANCE DEGRADATION ASSOCIATED WITH WEARING THE CHEMICAL DEFENSE ENSEMBLE (CDE) IS DUE TO THE BURDENS PLACED ON THE WEARER BY THE MASK AND HOOD COMBINATION. THE DEGRADATION OCCURS WHEN A MASK/HOOD IS WORN IS A FUNCTION OF A COMBINATION OF FACTORS. SEVERAL PHYSICAL PROBLEMS SUCH AS RESPIRATORY DIFFICULTY AND THERMAL STRESS ARE ASSOCIATED WITH MASK USAGE. WEARING PROTECTIVE MASKS CAN ALSO CREATE ADVERSE PSYCHOLOGICAL EFFECTS. LASTLY, PERCEPTUAL ABILITIES SUCH AS VISION, COMMUNICATIONS, AND FINE MOTOR DEXTERITY CAN BE SEVERELY HAMPERED. THE MISSION DEGRADATION OF RESPIRATORY PROTECTION DATABASE (MDRPDB) IS DESIGNED TO SERVE AS A TOOL FOR PROTECTIVE MASK/HOOD DESIGNERS. USING THIS SYSTEM DESIGNERS WILL BE ABLE TO EVALUATE DESIGN OPTIONS BEFORE THE MASK IS DEVELOPED. DESIGNERS WILL BE ABLE TO INVESTIGATE THE VARIOUS SOURCES OF DEGRADATION ASSOCIATED WITH WEARING A PARTICULAR MASK OR HOOD.

14. SUBJECT TERMS			15. NUMBER OF PAGES
CHEMICAL DEFENSE ENSEMBLE	VISION	COMMUNICATION	51
RESPIRATORY PROTECTION	MASKS	PSYCHOLOGICAL	16. PRICE CODE
THERMAL STRESS	HOODS	EFFECTS	
	DEXTERITY	MDRPDB	

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED	SAR

Final Report

on

User Guide for the Mission Degradation of Respiratory Protection Database (MDRPDB)

to

C. M. Grove and W. D. Kuhlmann
Advanced Protective Systems Integrated Laboratory
Edgewood Research, Development and Engineering Center

December, 1992

by

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Preface

This report for the Advanced Protective Systems Integration Laboratory of the Edgewood Research, Development and Engineering Center of the Test Methods, Requirements and Recommendations for future respirator design study was prepared under the Chemical Biological Information Analysis Center (CBIAC) contract with the Defense Logistics Agency Contract No. 900-86-C-2045, Task 336.

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1.0 INTRODUCTION

1.1 Overview

A significant portion of the performance degradation associated with wearing the Chemical Defense Ensemble (CDE) is due to the burdens placed on the wearer by the mask and hood combination. The degradation which occurs when a mask/hood is worn is a function of a combination of factors. Several physical problems such as respiratory difficulty and thermal stress are associated with mask usage. Wearing protective masks can also create adverse psychological effects. Lastly, perceptual abilities such as vision, communications, and fine motor dexterity can be severely hampered.

The goal of mask designers is to reduce the impact of these factors on task performance through improved mask designs. In order to predict and evaluate the extent to which performance burdens induced by the mask/hood can be relieved with a new mask/hood design, an automated system which quantitatively depicts the interrelationships between the various factors associated with wearing the protective mask/hood has been developed. Previous predictive models have dealt with physiological and performance issues, but most of these models and databases were developed using the Chemical Defense Ensemble (CDE) as a total system. This project is the first database and basic model which combines task performance, human abilities and mask design parameters to provide a predictor for new mask designs.

1.2 Purpose

The Mission Degradation of Respiratory Protection Database (MDRPDB) is designed to serve as a tool for protective mask/hood designers. Using this system designers will be able to evaluate design options before the mask is developed. Designers will be able to investigate the various sources of degradation associated with wearing a particular mask or hood.

1.3 Owner and Developer

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1.4 Computer Requirements

The Respiratory Protection Database was designed to operate on IBM compatible computers. The system will function on a 286 processor PC, but a 386 or larger processor is highly recommended. A color monitor is also recommended. The disk operating system (MS-DOS) should be at least version 3.1.

The system was developed using dBASE IV software which is required to access the database. Software requirements also include Microsoft Windows and Microsoft Excel for Windows. An algorithm to calculate time degradation due to protective masks was developed using the Excel spreadsheet software. Data must be copied from dBASE IV into Excel in order to use the algorithm. Excel can also be used to format data into tables or graphs.

1.5 Organization of User's Manual

This user's manual for the Mission Degradation of Respiratory Protection Database is organized into three main sections. The introductory section includes information about the background, purpose, computer requirements, and data sources for the system. The two following sections deal specifically with how to use the databases. Section 2 provides the information needed to access data within dBASE IV. The basic structure of the dBASE IV software is explained, and the Control Center which is used to access data is described. The structure and contents of the five databases which make up the MDRPDB are discussed. Finally, a section describing how to perform queries of the database is provided.

The third section of the manual deals with transferring data from dBASE IV into Excel and performing various functions. The procedure for copying the results of a query made in dBASE IV into Excel is provided. Details are provided concerning formatting data, once in Excel, into a form suitable for making printed copies. Also, techniques for creating various types of graphs from the data are discussed.

1.6 Security Requirements

The Mission Degradation of Respiratory Protection Database contains no classified materials. All data sources are either unclassified government technical reports or journal articles from professional journals.

1.7 Data Sources

The data contained within the five databases which make up the Respiratory Protection Database system has been extracted from several types of documents. The majority of the source documents are U. S. Army technical reports distributed by the Defense Technical Information Center (DTIC). The data contained in these documents was primarily task related performance and physiological data. In addition to the technical reports, a number of journal articles from professional medical and physiology journals were included in the database system. The studies reported in these articles concentrated on the physiological effects of wearing protective masks during various types of exertion. The tasks performed in the experiments consisted mostly of walking/running on a treadmill, and the masks worn were either commercial or modified military masks. Appendix A is a bibliography containing references for all of the data sources used in the system.

A large amount of task related data in the Respiratory Protection Database system came from the U. S. Army Chemical School's Physiological and Psychological Effects of NBC and Sustained Operations on Systems in Combat (P2NBC2) Database. The database structure of the P2NBC2 Database is similar in many ways to the Respiratory Protection Database system. Thus, it was possible to integrate the P2NBC2 data into this system without significant modifications. The P2NBC2 Database contains performance and physiological data from a number of field studies in which units performed various combat tasks while in the full Chemical Defense Ensemble (MOPP IV).

Most of the data in the Mask Parameters (MASKPARM) database was abstracted from the Chemical and Biological Defense Information Analysis Center's (CBIAC) Worldwide NBC Mask Handbook. This document contains parameters and specifications for a large number of U. S. protective masks.

2.0 Using the Databases in dBASE IV

2.1 dBASE IV Control Center

dBASE IV can be manipulated through commands typed at a dot prompt (similar to DOS) or through a menu system. The instructions and techniques discussed in this manual are based solely on the menu system. Users interested in accessing and manipulating the Respiratory Protection Database system through the dot prompt should refer to Using dBASE IV the dBASE IV user's manual. The dBASE IV user's manual should also be consulted whenever additional information is required, such as techniques for creating complex queries.

The navigational center of the dBASE IV menu system is called the Control Center. The various components of the database system are all accessed through the Control Center. Users of the Respiratory Protection Database system will most commonly use the following features within the Control Center: select a database to display, access data entry forms, prepare and print reports, and create queries.

In the following sections, the four types of files which will be used within the system are discussed. These four types of files are: databases, reports, forms, and queries. Each section will describe and provide instructions for using one of the four features.

2.1.1 Databases

Databases are essentially tables which organize large quantities of data into a useful structure. The structure of the database tables consists of a number of fields which contain specific types of data. Fields are organized by columns in the databases with the name of each field at the top of the column. Each set of data (document, task, trial, etc.) within the database is called a record, and each row of a database represents one record.

The Respiratory Protection Database system contains six databases. The Source database contains bibliographic and other information about each document from which data was abstracted. The other five databases contain the actual data for the system (see Figure 1). The structure and contents of these databases are described in the next section of the User's Manual. The databases are represented in the dBASE IV Control Center, and they can be selected by simply mouse clicking or pressing return on the desired database name.

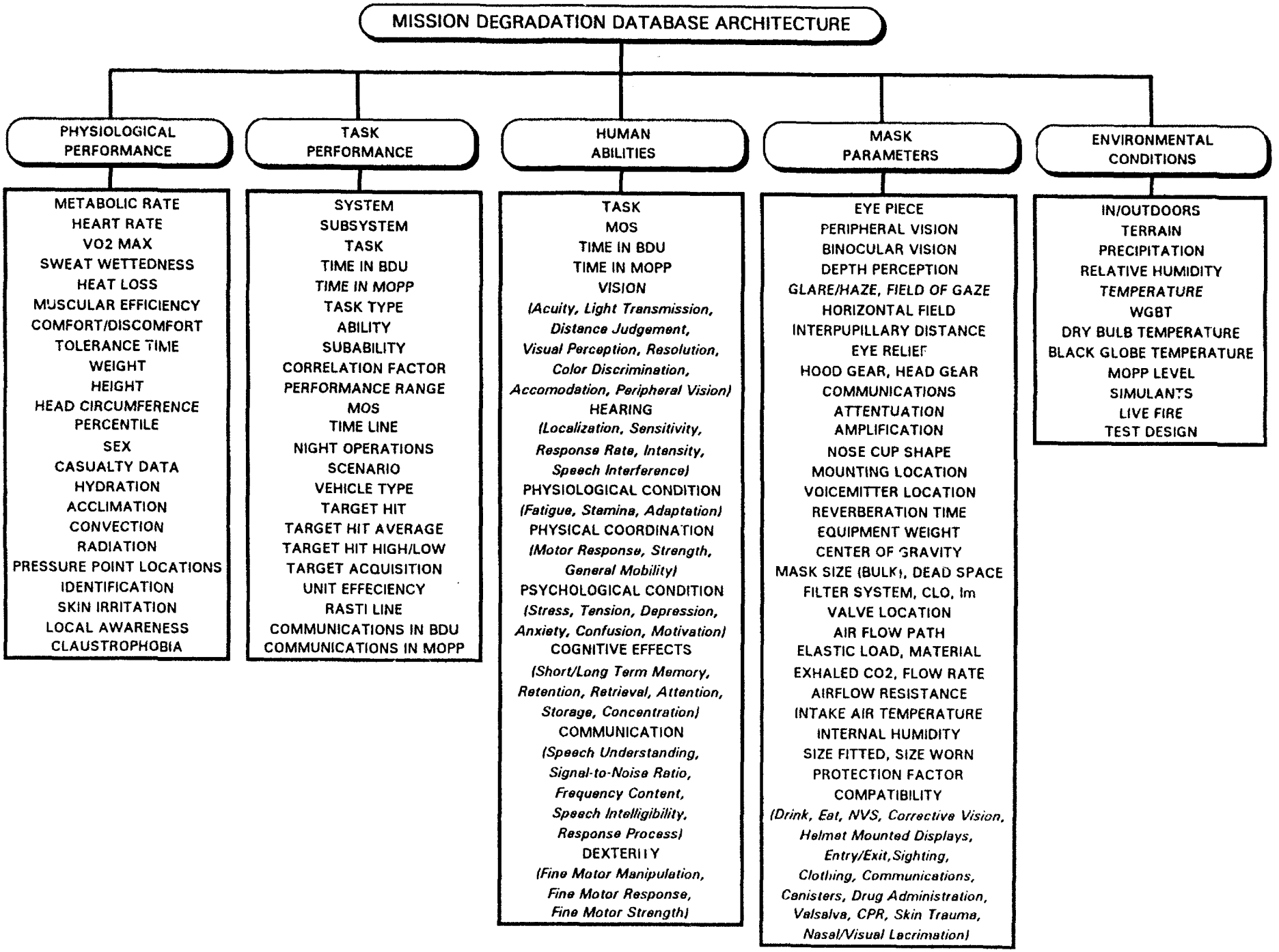

Figure 1. Mission Degradation Database Architecture

2.1.2 Reports

Reports are used to print databases and queries. Using reports, entire databases/queries or specific portions of a database/query can be printed. There are two types of reports in dBASE IV. A Quick Report is the fastest and easiest way to print data from a database or query. A Quick Report simply prints the selected database/query as it is without any additional formatting except for the date and a page number at the top of each page. The other type of report is the Custom Report. With the Custom Report, the user has much more control over what is printed and how the report is formatted. Instructions will only be provided concerning Quick Reports in this manual. Users wishing to create Custom Reports should consult Using dBASE IV. Many of the added capabilities for customizing a print out using a Custom Report are also available when dBASE files are accessed through Ex el (see Section 3).

To print a Quick Report, first highlight the database or query you want to print, in the Control Center. Then press **Shift-F9 Quick Report**, and the print menu will appear. Make any desired changes of the print options then press return to begin printing. The system will include one Custom Report file for each of the five databases. These reports are simply Quick Reports of each database that have minor enhancements. The field names at the top of each column are spelled out instead of the abbreviations used in the database file. To print any of these Custom Report files simply click on the desired report name, and then select the print command.

2.1.3 Forms

Forms are specially designed screens used to look at and/or modify data in a database or query file. Form design files do not contain data; they contain designs for forms. In this system, forms are used primarily for data entry. Thus the user will probably use the available forms very rarely. Each form is connected with one database, and they can be used to view the data from that database one record at a time.

2.1.4 Queries

Queries are used to organize and manipulate data. There are two types of queries in dBASE IV. VIEW queries contain a portion of the data contained in one or more databases. For example, a view query could be created which contains the data for several fields from two or more separate databases. View queries can be saved, and then used much as another database. A user can display, enter, and edit data in a query file just as in a database. Also, reports can be made from queries just as they are from databases. Update queries provide a way to make broad changes to a database file. They can be used to append new data, define groups of records to be deleted or undeleted, and replace data in fields that meet a specified

condition. Most users of this system will make use of view queries far more than update queries. Because much of the use of this system will involve creating and using queries, a separate section dealing with strategies for making queries is provided (see Section 2.3).

2.2 Structure and Content of the Databases

The Respiratory Protection Database system is made up of six databases. One database, called the Source database, contains bibliographic information for the data sources used in the system. The other five databases contain the information abstracted from the data sources. The data was spread into multiple databases, rather than having one very large database, to make the system easier to manage and use. Each one of the five databases contains related fields which pertain to one of the main areas (term) of interest for mask design. The five databases are: Task Performance, Human Abilities, Environmental Conditions, Mask Parameters, and Physiological Data. The databases' contents are briefly described in the following sections, and a complete list of field names with descriptions, for each database, is provided in Appendix B.

2.2.1 Task Performance

The Task Performance database (TASK) contains data which describe the tasks performed in field and laboratory studies. For most of the documents, there is one record in TASK for each task in the study. This database has fields such as "system" and "task" which describe the task. Also included in TASK are fields concerning performance for the task (e.g., time to complete task, percent accurate communications, and target hit average). In most cases, a record in TASK has a corresponding record in both the Human Abilities and Environmental Conditions databases.

2.2.2 Human Abilities

Each record in the Human Abilities database (ABILITY) contains a breakdown of the abilities and sub-abilities involved in performing a particular task. In almost all cases, a record in the ABILITY database has a corresponding record in the TASK database which describes the task involved. For each record, each of the eight ability categories has been assigned a percentage based on how much of the task involves that particular ability. If a task does not require certain abilities, those abilities are recorded as 0%. The sum of the ability percentages must be 100%. Each ability has several sub-abilities under it, and abilities which are required for the task (abilities for which the percent is more than 0) also have percentage values assigned to the relevant sub-abilities with a total of 100%. The distribution of the ability and sub-

ability percentages is based on knowledge of the task from either the report or from individuals familiar with the tasks. Appendix C is a list of the abilities and sub-abilities with definitions provided.

2.2.3 Environmental Conditions

This database contains information about the environmental conditions during the trial, study, etc. . This includes fields such as: was the trial conducted indoors or outdoors, temperature, and simulant information. As mentioned above, most records in the Environmental Conditions database (ENVIRO) have a corresponding record in the TASK database.

2.2.4 Mask Parameters

The Mask Parameters database (MASKPARM) contains a variety of specifications and compatibility data for a number of protective masks. Most of the masks included in the MASKPARM database are U. S. military masks. However, there are a few records for non-U. S. military masks and commercial masks.

2.2.5 Physiological Performance

The Physiological Performance database (PHYSIO) focuses on the physiological impact a task has on subjects and their demographic information. Topics included in the PHYSIO database include: anthropomorphic data, physical workload, and psychological stress. A large portion of the data in the PHYSIO database came from professional journal articles in which the physiological effects of wearing masks during exercise were studied.

2.3 Query Strategies

As discussed in section 2.1.4, there are two types of queries which can be made in dBASE IV. Update queries are used to make large changes to databases, such as adding new data, deleting groups of records, or replacing certain data. Users of this system will rarely, if ever, need to create update queries. The other type of query is the view query. It is used to create a subset of data from one or more databases.

View queries can be created in several different ways, and they can include a variety of features. For these reasons this section will not provide detailed instructions concerning the design of view queries. Instead, some general instructions and strategies for creating helpful queries are provided. Users should

consult Using dBASE IV, the dBASE IV user's manual, for detailed instructions for creating view queries. Chapters 6 and 7 of Using dBASE IV cover all aspects of the design and use of view queries.

Views are developed at the Queries Design Screen (QDS). The QDS is accessed through the Control Center by clicking on either the file name of an existing query or the "<create>" option in the Queries panel of the Control Center. If the INSTRUCT function (under Settings in the Tools menu of the Control Center) is on, a prompt box will appear. Select **Modify query** to get to the QDS.

The QDS contains four types of elements. Database files are represented by **file skeletons** which display the database name and the names of the database's fields across the upper part of the QDS. Up to eight file skeletons (representing eight different database files) can be used on one QDS. **View skeletons**, which are displayed at the bottom of the QDS, represent the fields which the user has selected (from the file skeletons) to be in that view. A third element, the **calculated field skeleton**, is used to create calculated fields for the view. The calculated field skeleton, if one is needed, appears just above the view skeleton. The last element is the **condition box**, which is an optional feature of the QDS. It is used to enter complex filter conditions that involve multiple fields (condition boxes are discussed in chapter 7 of the dBASE IV user's manual).

Most of the commands for navigating around on the QDS are displayed at the very bottom of the screen (a complete list of navigational commands is provided on page 6-6 of the dBASE manual). The various functions and commands used in creating and managing a view query are accessed through function keys (i.e., F2 Data) and several menus at the top of the QDS. The relevant function keys, at any particular point during manipulation of a view, are displayed at the bottom of the QDS. By mouse clicking on the required function key display, the command is executed without actually pressing the function key on the keyboard. There are five menus at the top of the QDS. These are: Layout, Fields, Condition, Update, and Exit. The Layout menu controls commands which affect the entire view. Using the Layout menu, database files can be added to or removed from the list of file skeletons. Through Layout the user can write the current view as a database file, and the view can be saved without exiting back to the Control Center. As the name implies, the Fields menu controls the fields being used in the view. Fields can be add to or removed from the view. The user can also edit a field's name in the view with the Fields menu. Calculated fields are controlled through the Fields menu as well as indexing of records. The Condition menu contains commands to add or delete a condition box. Update queries are created through the Update menu. The Exit menu allows the user to exit the view with or without saving any changes which have been made.

Creating view queries will serve several purposes for users of the Respiratory Protection Database system. Users can create a view containing only the fields or records which are of interest at that time, and by writing view queries as database files, smaller databases with fields related to a specific topic can be created. Using these view queries will save time and effort because the user does not have to sort through

unwanted data. A number of views can be generated, each containing a coherent subset of the larger database, useful for examining a particular issue.

Another useful aspect of view queries for users is the ability to create a view which contains fields from more than one database (see NOTE about DB_CODE field in Appendix B). For example, a user interested in the effects of various climates on physiological states could create a view which contains various weather related fields from the ENVIRO database with a subset of the physiological data fields from the PHYSIO database. Again, this type of view can be written as a specialized database. Within a view query, calculated fields can be generated by performing a set of computations on the data from one or more existing fields. Using this feature, users can increase the number of useful fields that are available. Creating tables and charts using Excel will be easier when the file that is accessed is a query file rather than one of the large database files. The user does not have to sort through a large number of fields which he/she does not want included in the chart. In general, view queries will allow Respiratory Protection Database system users to customize the available data into more functional units.

3.0 Using the Database in Excel

3.1 Accessing Databases in Excel

To open a database file or query file in Excel, choose Open from the File menu. Excel will list the files in the current directory. In the dialog box, a different drive and directory can be selected. Excel lists all the files of one type under the LIST Files Of Type box. The database files will be listed as *.dbf and queries as *.qbe.

3.2 Reports

After opening the desired files, Excel will automatically format the worksheet by placing field names at the top of each column and records across each row. The rows and columns can be adjusted to provide a best fit of the data. To quickly adjust columns, double click the line to the right of the column heading. To quickly adjust rows, double click the line below the row heading. Reports are generated by using the Print option from the File menu. Reports should be saved with a *.xls extension

3.3 Charts

Graphical representation of mask data can be created in Excel by using the ChartWizard tool. Simply select the range of cells that contain data and click the ChartWizard tool which is located on the right side of the tool bar. Next, use the mouse pointer to click the first corner of the chart and drag until the box is the desired shape and size. After following a five step sequence, the chart will appear in the box. The chart can be opened by double clicking the box and saved as a *.xlc file.

3.4 Mask Degradation Representation

The equation developed to use the data from the abilities database calculates the increased time to perform a task wearing a protective mask and hood. The equation considers the distribution of increased task time across eight human ability categories (Ramirez, 1986) and 41 subabilities. Each task is broken down into abilities of human performance. A literature search was performed to identify or in some cases estimate the percent of task distribution. This information can be incorporated into the equation:

T_b	=	Time to accomplish task in BDU
T_i	=	Increased time due to the mask
Tm	=	Total task time with mask
$\%_{ab}$	=	percent of distribution of task
T_{ab}	=	Time distribution of that particular ability in BDU
$\%_{d'ab}$	=	percent of degradation due to the Mask for that particular ability
$T_{d'ab}$	=	Time distribution due to degradation of the mask for that particular ability

$$T_{ab} = \%_{ab} \times T_b$$

$$T_{d'ab} = T_{ab} \times \%_{d'ab}$$

$$T_i = \Sigma [T_{d'ab^n}]$$

$$Tm = T_i + T_b$$

To use this equation, desired records from the Human Abilities database must be queried and saved separately as *.dbf files in dBase IV. Once this is accomplished, open the task_deg.xls file in Excel. Excel will list files in the current directory in a dialog box named Enter dBase File. In the dialog box, a different drive and directory can be selected. Next, open one of the desired abilities *.dbf files from the dialog box. Excel will automatically format the abilities spreadsheet with the appropriate times and percentages. Reports can be generated by using the Print option from the File menu.

3.4.1 Abilities Spreadsheet

The abilities spreadsheet (see Figure 2) is a powerful computational tool which displays the task distribution and mask degradation across eight human abilities and 41 sub-abilities. As shown in Figure 2, percentages are assigned to human abilities of a particular task. There are two columns of percentages. The first column calculates the time to complete a task in BDU for particular abilities and subabilities. The second column calculates the increased time due to mask degradation. The total time with and without the mask is displayed on the left side of the spreadsheet.

Figure 2. Mask Degradation Representation Algorithm Output

dbase file name

Task

Task 1

Task Time w/o Mask

60.0 min

Task Time w/ Mask

88.8 min
48% increase

Human Ability w/ Subcategory	Task Distribution: Distribution of Task (%)	Task Distribution: Time Dist. of Task	Mask Effects: Degradation Due to Mask (%)	Mask Effects: Time Dist. of Deg.
VISION	40	24.0 min	50	12.0 min
ACUITY	100	24.0 min	100	12.0 min
ACCMOD				
DISTJM				
PERCPT				
COLRDS				
PERIPH				
RSOLUT				
LTRSMN				
HEARING				
LOCAL				
SENSIT				
RESPRT				
SPCHIF				
INTENS				
PHSIOCON	10	6.0 min		
FATIGE	60	3.6 min	60	
STAMNA	40	2.4 min	40	
ADAPTN				
PHYSCORD				
MOTRSP				
GENMOB				
STRNTH				
PHYCHCON				
STRESS				
TENSIN				
DEPRES				
ANXIET				
CONFUS				
MOTIVA				
COGNEFFS				
SHTMEM				
LGRMEM				
RETENT				
RETRIV				
STORAG				
CONCEN				
ATTENT				
REASON				
COMMICAT	30	18.0 min	60	10.8 min
SPUNDS	20	3.6 min	20	2.2 min
SIG2NR				
FRQCNT				
SPEECH	80	14.4 min	80	8.6 min
RESPRC				
DEXTERIT	20	12.0 min	50	6.0 min
FMMANP				
FMRESP	100	12.0 min	100	6.0 min
FMSTRG				
Totals		100	60.0 min	28.8 min

4.0 Enhancements and Data Gaps

4.1 Enhancements

The Respiratory Protection Database system has one area in which some additional data would greatly increase the value of the entire system. The algorithm, written in Excel, for computing the increase in time to complete a task when a mask is worn requires a percentage value for the amount of degradation, due to the mask, for each of the eight human ability categories. At this time, the percent degradation must be estimated because no definite values are available. Having to use estimated values in the algorithm makes the output less valid. Determining degradation percentages for the human ability categories would require empirical laboratory or field studies. However, the result would be a more valuable predictive tool for mask designers.

The system could also be enhanced by further developing the algorithm or adding a second algorithm with a slightly different purpose. The current algorithm uses degradation percentages at the human ability level. Modifications could be implemented that would make the algorithm compute the increase in task time due to the mask based on degradation percentages at the sub-ability level rather than the ability level. This would provide the user with a more detailed picture of how the mask affects task performance. However, the lack of empirically based degradation percentages, discussed above, would also be a problem with this modified algorithm.

4.2 Data Gaps

The following areas of the database either contain sparse data or no data at all. Data collection in these areas should be concentrated on to provide a complete tool for the mask designers, developers and users.

Some areas contain few data gaps. The Task Performance database has sparse communication and target hit rate data, and the Environmental Conditions database has no black-bulb temperature data and sparse type of precipitation data.

Significant data gaps exist in the Physiological Performance database. Specifically, the database contains no data for heat loss, convection, radiation, muscle efficiency, head circumference, and overall anthropomorphic information. In addition, the Physiological Performance database contains sparse comfort rating, amount of liquid consumed (hydration), location of skin irritation, location of pressure points, subject awareness of local surroundings, subject comments, and casualty data.

The Mask Parameters database also contains significant data gaps including sparse insulation, impermeability, and protection factors, valsulva maneuver and CPR compatibility, nose cup shape, volume of the mask's bulk, and peripheral vision data. The data base contains no eye piece, binocular vision, depth perception, amount of glare of haze, field of gaze, attenuation, amplification, reverberation time, center of gravity of and elastic load of mask, amount of exhaled carbon dioxide, intake air temperature, internal humidity, drug administration and treatment of skin trauma compatibility, and nasal and visual lacrimation compatibility data.

Appendix A

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Appendix B

MDRPDB Field Names and Descriptions

SOURCE.dbf

Field Name	Complete Name
SOURCE	A reference to the original document the data in this record was abstracted from
CLASS	The security classification of the document
DTIC	The Defense Technical Information Center number for the document, if one was available
CBIAC	The Chemical and Biological Defense Information Analysis Center number for the document, if one was available
TITLE	The title of the document
AUTHOR	Author(s) of the document
PERFORM_AG	Agency which wrote the document and/or conducted the research reported the document
DATE	Date the document was completed or published
TYPE_DOCMT	Type of document: technical report, journal article, etc.
JOURNAL	Name of the journal in which the document appeared, if applicable
VOLUME_NUM	Journal volume number, if document was from a journal
ISSUE_NUM	Journal issue number, if document was from a journal
PAGE_NUM	Journal page numbers of the document, if document was from a journal
ADDRESS	Address of either the journal in which the document was published or the performing agency if the document was a technical report
KEYWORDS	Databases containing data from this document in all CAPS Document keywords in lower case
ABST_PART#	Abstract contained in the document Up to eight fields depending on length of abstract

TASK.dbf

Field Name	Complete Name
SOURCE	A reference to the original document from which the data in this record was abstracted

TASK.dbf (Continued)

Field Name	Complete Name
DB_CODE	Database code: common field used for linking two databases, uniquely identifies each record. **NOTE:** For most of the documents, the number of records in each database is the same, and the DB_CODE data is the same across databases. However, for some of the documents, there are different numbers of records from one database to the next. This means the common field (DB_CODE) does not have a matching unique value for each record across databases. *This means the databases cannot be linked for those documents.*
TITLE	The title of the document
MOPP_LEVEL	Level of MOPP gear worn by subjects in the study. MOPP5 represents, subjects wore mask only, no other protective gear.
SYSTEM	The system on which the task was performed
SUB_SYSTEM	The sub-system on which the task was performed
TASK	Task performed in the study
COM_BDU	Percent accurate communications in BDUs
COM_MOPP	Percent accurate communications in MOPP (including MOPP5 - mask only)
TIME_BDU	Time to perform the task wearing BDUs
TIME_MOPP	Time to perform the task in MOPP gear (including MOPP5 - mask only)
TASK_TYPE	Type of task: fine motor, gross motor, or cognitive/perceptual
ABILITY	The primary Human Abilities used in the task
SUBABILITY	The primary Human Subabilities used in the task
COR_FACTOR	Performance degradation factor (PDF), MOPP time / BDU (MOPP0) time
PR_RNGE_L	The lowest PDF value found
PR_RNGE_H	The highest PDF value found
MOS	Military Operation Specialty
RASTI_TEST	
TIME_LINE	The sequence of events during the task
NIGHT_OP	Night operations (Yes or No)
SCENARIO	The scenario of the mission
VEH_TYPE	Vehicle type used during task: Auto=1, Trailer=2, Truck=3, Tank=4, Aircraft=5
TARGET_HIT	Average target hit rate in MOPP
T_HIT_AVG0	Average target hit rate in BDUs/MOPP0
T_HIT_LO_0	Lowest value, range of target hits in MOPP0
T_HIT_HI_0	Highest value, range of target hits in MOPP0
T_HIT_LO_4	Lowest value, range of target hits in MOPP#
T_HIT_HI_4	Highest value, range of target hits in MOPP#
TARGET_AQ	Average target acquisition rate in MOPP#
UNIT_EFF	Unit ineffectiveness time (in minutes)

ABILITY.dbf

Field Name	Complete Name
SOURCE	Source number
DB_CODE	Database code
TASK	Description of task performed
MOS	Military Operational Specialty code
ABILITY	The primary Human Abilities used in the task
SUBABILITY	The primary Human Subabilities used in the task
TIME_BDU	Time to perform the task wearing BDUs
TASK_TIME	Time to perform the task in MOPP gear
MOPP_LEVEL	Level of MOPP gear worn by subjects in the study
VISION_PCT	Percent of task requiring Vision
VISN_DEGR	Percent of Visual degradation caused by the mask
VISN_DSCPT	Description of Vision part of task
ACUTIY_PCT	Percent of task requiring Acuity
ACUT_DSCPT	Description of Acuity part of task
ACCOMD_PCT	Percent of task requiring Accommodation
ACCM_DSCPT	Description of Accommodation part of task
DISTJM_PCT	Percent of task requiring Distance Judgments
DIST_DSCPT	Description of Distance judging part of task
PERCPT_PCT	Percent of task requiring Visual Perception
PERC_DSCPT	Description of Visual Perception part of task
COLRDS_PCT	Percent of task requiring Color descrimination
CLDS_DSCPT	Description of Color usage in the task
PERIPH_PCT	Percent of task requiring Peripheral vision
PERI_DSCPT	Description of Peripheral vision part of task
HEARIN_PCT	Percent of task requiring Hearing
HEAR_DEGR	Percent of Hearing degradation caused by the mask
HEAR_DSCPT	Description of Hearing part of task
LOCAL_PCT	Percent of task requiring Sound Localization
LOCL_DSCPT	Description of Localization part of task
SENSIT_PCT	Percent of task requiring sound Sensitivity
SENS_DSCPT	Desription of Sensitivity part of task
RESPRT_PCT	Percent of task involving Response Rate
RESP_DSCPT	Description of Response Rate part of task
SPCHIF_PCT	Percent of task involving Speech Interference
SPIF_DSCPT	Description of Speech Interference part of task
INTENS_PCT	Percent of task involving Intensity of Sound
INTN_DSCPT	Description of Sound Intensity part of task
PHSIOC_PCT	Percent of task involving Physiological effects
PHSI_DEGR	Percent of Physiological degradation caused by the mask
PHSI_DSCPT	Description of Physiological effects part of task

ABILITY.dbf (Continued)

Field Name	Complete Name
FATIGE_PCT	Percent of task involving Fatigue
FATG_DSCPT	Description of Fatiguing part of task
STAMNA_PCT	Percent of task requiring Stamina
STAM_DSCPT	Description of Stamina requiring part of task
ADAPTN_PCT	Percent of task requiring Adaptation
ADPT_DSCPT	Description of Adaptation part of task
PHYSCD_PCT	Percent of task involving Physical Coordination
PHYS_DEGR	Percent of Physical Coordination degradation caused by the mask
PHYS_DSCPT	Description of Physical Coordination part of task
MOTRSP_PCT	Percent of task involving Motor Response
MOTR_DSCPT	Description of Motor Response part of task
GENMOB_PCT	Percent of task requiring General Mobility
GENM_DSCPT	Description of General Mobility part of task
STRNTH_PCT	Percent of task requiring Strength
STRN_DSCPT	Description of Strength part of task
PSYCHC_PCT	Percent of task involving Psychological Effects
PYCH_DEGR	Percent of Psychological degradation caused by the mask
PYCH_DSCPT	Description of Psychological Effects part of task
STRESS_PCT	Percent of task involving Stress
STRS_DSCPT	Description of Stressful part of task
TENSIN_PCT	Percent of task involving Tension
TENS_DSCPT	Description of Tension causing part of task
DEPRES_PCT	Percent of task affecting Depression
DEPR_DSCPT	Description of Depression causing part of task
ANXIET_PCT	Percent of task causing Anxiety
ANXT_DSCPT	Description of Anxiety causing part of task
CONFUS_PCT	Percent of task causing Confusion
CONF_DSCPT	Description of Confusion causing part of task
MOTIVA_PCT	Percent of task requiring Motivation
MOTV_DSCPT	Description of Motivation requiring part of task
COGNEF_PCT	Percent of task requiring Cognitive Abilities
COGN_DEGR	Percent of Cognitive Abilities degradation caused by the mask
COGN_DSCPT	Description of Cognitive part of task
SHTMEM_PCT	Percent of task requiring Short-term Memory
SHTM_DSCPT	Description of Short-term Memory part of task
LGTMEM_PCT	Percent of task requiring Long-term Memory
LGTM_DSCPT	Description of Long-term Memory part of task
RETENT_PCT	Percent of task requiring Retention
RETT_DSCPT	Description of Retention part of task

ABILITY.dbf (Continued)

Field Name	Complete Name
RETRIV_PCT	Percent of task requiring Retrieval
RETV_DSCPT	Description of Retrieval part of task
STORAG_PCT	Percent of task requiring Storage of information
STRG_DSCPT	Description of Storage part of task
CONCEN_PCT	Percent of task requiring Concentration
CONC_DSCPT	Description of Concentration part of task
ATTENT_PCT	Percent of task requiring Attention
ATTN_DSCPT	Description of Attention requiring part of task
REASON_PCT	Percent of task requiring Reasoning ability
REAS_DSCPT	Description of Reasoning part of task
COMMIC_PCT	Percent of task involving Communication
COMM_DEGR	Percent of Communication degradation caused by the mask
COMM_DSCPT	Description of the Communication part of task
UNDSPC_PCT	Percent of task requiring Speech Understanding
UDSP_DSCPT	Description of the Speech Understanding part of task
SIG2NS_PCT	Percent of task involving Signal-to-Noise Ratio
SG2N_DSCPT	Description of Signal-to-Noise Ratio for the task
FREQCT_PCT	Percent of task involving Frequency Content
FQCT_DSCPT	Description of Frequency Content for the task
SPCHCL_PCT	Percent of task involving Speech Intelligibility
SPCH_DSCPT	Description of Speech Intelligibility task
RESPRC_PCT	Percent of task requiring a Response Process
RSPR_DSCPT	Description of Response Process
DEXTER_PCT	Percent of task requiring Dexterity
DEXT_DEGR	Percent of Dexterity degradation caused by the mask
DEXT_DSCPT	Description of Dexterity requiring part of task
FMMANP_PCT	Percent of task requiring Fine Motor Manipulation
FMMP_DSCPT	Description of Fine Motor Manipulation part of task
FMRESP_PCT	Percent of task requiring Fine Motor Response
FNRP_DSCPT	Description of Fine Motor Response part of task
FMSTRG_PCT	Percent of task requiring Fine Motor Strength
FMST_DSCPT	Description of Fine Motor Strength part of task

ENVIRO.dbf

Field Name	Complete Name
SOURCE	Source Number
DB_CODE	Database Code
I_O_DOORS	Location where the task is performed: Indoors/Outdoors
TERRAIN	Type of terrain

ENVIRO.dbf (Continued)

Field Name	Complete Name
WEATHER	Type of precipitation
PRECIPT	Precipitation
REL_HUMID	Relative Humidity
TEMP	Temperature (F)
WBGT	Wet Bulb Globe Temperature
DRY_BULB	Dry Bulb Temperature
BLCK_GLOBE	Black Globe Temperature
MOPP_LEVEL	Level of MOPP gear worn
SIMULENTS	Was a simulent used in the study? Yes / No
SIMULENT	Name of simulent used
LIVE_FIRE	Was the task performed with live fire? Yes / No
TESTDESIGN	Summary of the test design

MASKPARM.dbf

Field Name	Complete Name
SOURCE	Source Number
DB_CODE	Database Code
NAME	Name of mask/hood worn during study
MANUFACT	Manufacturer of the mask/hood
DESCP_EYE	Description of eyepiece
EYE_PIECE	Field of Vision - degrees
PERIPHERAL	Peripheral Vision - degrees
BINOCULAR	Binocular Vision - degrees
DEPTH_PERC	Depth Perception - feet
AMT_GLRHAZ	Amount of glare or haze
FIELD_GAZE	Field of Gaze - degrees
BLO_HORZFD	Field of Gaze below horizontal field - percentage
PUPIL_DIST	Interpupillary distance - millimeters
EYE_RELIEF	Eye Relief distance - millimeters
HOOD_GEAR	Type of hood gear
HEAD_GEAR	Type of head gear
COMM	Type of communication equipment
ATTENUATN	Attenuation
AMPLFICATN	Amplification percent
NOSE_CUP	Shape of nose cup
LOC_VOICMT	Location of the voicemitter
RVERB_TIME	Reverberation time
FACE_PC_WT	Face Piece weight - pounds
FILTER_WT	Filter weight - pounds
TOTAL_WT	Total weight - pounds
CNTR_GRAVT	Center of Gravity

MASKPARM.dbf (Continued)

Field Name	Complete Name
VOL_MKBULK	Volume of the mask bulk
FILTER_SYS	Type of filter system
VALVE_LOC	Valve location
AIRFLOPATH	Airflow Path
ELASTCLOAD	Elastic load
DEAD_SPACE	Volume of dead space - liters
EXHALD_CO3	Exhaled carbon dioxide - liters
FLOW_RATE	Flow rate - liters/minute
AF_RES_EX	Airflow resistance, exhalation - mm of H2O
AF_RES_IN	Airflow resistance, inhalation - mm of H2O
IN_AIR_TEM	Intake air temperature - farenheit
INTL_HUMID	Internal humidity - percentage
MATERIAL	Material used in the mask
CLO	Insulation factor
IM	Impermeability factor
PROTECT_X	Protection factor
DRINKNG_CP	Drinking compatible
EATING_CP	Eating compatible
HELMDIS_CP	Helmet Mounted Display compatible
NTVSGOG_CP	Night Vision Goggle compatible
CORRVIS_CP	Corrective Vision compatible
CORR_TYPE	Type of corrective vision device
RIFLE_CPAT	Rifle compatibles
HELMET_CPT	Helmet compatible
SIGHTNG_CP	Sighting compatible
CLTHING_CP	Clothing compatible
COMMICN_CP	Communications compatible
CANISTR_CP	Canister compatible
OTHER_CP	Other compatibilities
DRUGADM_CP	Drug administration compatible
VALSMAN_CP	Valsalva Maneuver compatible
CPR_COMPAT	CPR compatible
SKNTRAMACP	Treatment of skin trauma compatible
NASLACR_CP	Nasal lacrimation compatible
VISLACR_CP	Visual lacrimation compatible
DESCRIPT	General Description (information not covered in other fields)

PHYSIO.dbf

Field Name	Complete Name
SOURCE	Source Number
DB_CODE	Database Code
NAME	Name of mask/hood
METABOL_RT	Metabolic work rate
HEART_RATE	Heart rate (In most cases, refers to rate during last minute of task.)
MIN_VOL	Minute volume - liters/minute
SWEAT_WET	Sweat wettedness
HEAT_LOSS	Heat loss
CONVECTION	Convection
RADIATION	Radiation
MUSCUL_EFF	Muscle efficiency
COMFRT_DIS	Comfort rating: 1- comfortable, 2- slightly uncomfortable, 3- uncomfortable, 4- very uncomfortable, 5- intolerable
TOLER_TIME	Tolerance time - minutes
ANTHRO_WT	Weight - pounds
ANTHRO_HT	Height - inches
ANTH_HEAD	Head circumferance - inches
ANTH_PCTL	Overall anthropomorphic percentile
PSR_PT_LOC	Location of pressure points
IDENTIFCTN	Could subjects identify others when wearing the mask?
SKN_IR_LOC	Location of skin irritations
LOC_AWARE	Were subjects aware of their local surroundings after wearing the mask?
CLAUSTROPH	Did the subjects experience claustrophobia or hyperventilation?
SEX	Gender of subjects
CASLTY_DAT	Casualty data: injuries or problems while wearing the mask
HYDRATION	Amount of liquid consumed by the subjects - milliliters
ACCLIMATN	Level of acclimation to the mask
COMMENTS	Did the report include subject comments?
C_PAGE_NUM	If comments included in report, page numbers

Appendix C

Human Abilities and Definitions

Vision (VISION)	Use of acuity, accommodation, depth perception, adaptation, color discrimination, and peripheral vision to perform a task.
Acuity (ACUITY)	The precision with which one can see fine details. Sharpness of sight as measured by the ratio between the distance at which the subject can see a given object and the distance at which a person with normal (20/20) vision can see it.
Accommodation (ACCMOD)	The process by which the lens changes shape in accordance with the distance of the object being viewed. Since the eye can focus sharply on only one object at a time, objects at other distances are defocused and unclear to greater or lesser degrees.
Distance Judgment (DISTJM)	The ability of an observer to estimate distances of objects. According to Bailey (1982), people tend to underestimate distances. Distance judgment may become very distorted in unusual environments (e.g., space, underwater). For example, the stated distance that expert swimmers judge they travel underwater is very inaccurate.
Visual Perception (PERCPT)	Awareness of the environment or environmental situations obtained through the interpretation of visual input data.
Color Discrimination (COLRDS)	The ability to differentiate between colors. Deficiencies in color discrimination (occurring in 8 percent of the male population) may degrade performance in tasks that use color coding if no backup code exists.
Peripheral Vision (PERIPH)	This term refers to visual function for objects imaged approximately 6 degrees or more from the center of the fixation point. The further the image is from the fovea, the less clearly its shape can be perceived. Form recognition is possible for objects within 6 to 20 degrees from the fovea. Objects in the middle field (20 to 40 degrees) are not seen clearly, but movement and strong visual contrasts (brightness) are noticed. Objects in the outer field (40 to 70 degrees) are not noticed unless they move.

Auditory Detection (HEARING)	The sensitivity to sounds (other than verbal communication), and interpretation of sounds.
Localization (LOCAL)	The ability to accurately determine the direction of a sound source. Human discrimination between sound sources located to the right and left of the head is very good even when the head is immobile. Front-back and up-down discrimination is most often much poorer and more degraded when wearing the hood of the protection garment.
Sensitivity (SENSIT)	The absolute discrimination of the human ear as measured by the least sound pressure which leads to a sensation of hearing the normal human ear is maximally sensitive to the frequencies between 100 and 3000 Hz. Sensitivity falls off above and below this frequency range.
Response Rate (RESPRT)	Woodworth (1938) and Bailey (1982) note that response to an auditory stimulus is more rapid than reaction to other sensory modalities (pain being the slowest). Humans hear a signal and respond to it, on average, in 150 milliseconds (vision takes 200 ms and pain 700 ms).
Speech Interference (SPCHIF)	The shift downward in threshold of intelligibility of speech due to the presence of other interfering sounds or due to degradation of the speech signal by the mask filtering.
Intensity- speech signal (INTENS)	As intensity of speech is increased above threshold, articulation and intelligibility scores increase exponentially. Intensity and speech intelligibility are correlated and intensity can be easily controlled by amplification.
Physiological Conditions (PHSIOCON)	Tactile pressure, fatigue, personal needs, and stamina experienced in performance of tasks.
Fatigue (FATIGE)	This term refers to a disinclination for exerting effort and a corresponding drop in efficiency or performance. Both of these conditions are usually relieved by a rest period.
Stamina (STAMNA)	The capacity to continue an effort requiring exertion over a lengthy time period.
Adaptation (ADAPTN)	Usually refers to a reduction or loss of sensitivity or responsiveness to stimulation (or unusual stimuli) due to repetitiveness of the situation. For example, one might not notice a loud siren after continued exposure to the sound.

Physical Coordination (PHYSCORD)	The ability to climb, drive, walk, use general mobility, and muscular strength.
Motor Response (MOTRSP)	This refers to responses involving muscular movements of the striated muscle, as opposed to glands. The term "motor" is intended to refer to muscular actions and includes both gross and fine motor coordination.
General Mobility (GENMOB)	The ability to move without limitations. The range of movements may differ for individuals, with slender persons having greater movement range than obese or muscle-bound individuals.
Strength (STRNTH)	Refers to muscular capacity to exert force under static conditions. Strength may vary with muscle size, body position, motivation, fatigue and other factors.
Psychological Effects (PSYCHON)	Levels of stress, tension, depression, anxiety, confusion, and motivation.
Stress (STRESS)	Any aspect of human activity or of the environment which results in an undesirable effect on the individual. According to McCormick (1976), some sources of stress are: heavy work, immobilization, extreme cold, noise, vibration, heat, and sleep loss. One may view stress as a human physiological response to adverse circumstances. The response manifests itself in terms of physiological changes such as increased secretion of adrenaline and other "performance" substances such as catecholamine.
Tension- muscular (TENSIN)	Increased tension of the skeletal muscle during stress as measured by an electromyograph (EMG). During stressful situations, there are subjective reports of tension, including tightness of neck muscles, leg cramping, stiffness of shoulder muscles, and headache. According to Malmo (1959), persistent muscular tension is one symptom of stress.
Depression (DEPRES)	An affective state characterized by inactivity, sadness, loss of motivation to initiate activity and persisting autonomic nervous system effects such as insomnia.
Anxiety (ANXIET)	An unpleasant emotional state accompanied by physiological arousal and ill-defined cognitive elements such as a sense of impending disaster. There is no specific external stimulus for the fear-like states. Thus, anxiety differs from fear in that it is a general or diffuse response without an observable specific stimulus.
Confusion (CONFUS)	A state characterized by disorganized behavior. A disturbance in the organization and planning of response sequences. Such states of disorganized response may be related to extremely high levels of arousal or brain reticular system activation. Extremely high levels of arousal are known to have devastating effects on performance.

Motivation (MOTIVA)	The reason(s) for a subject's tendency towards action in a given situation. Readiness for activity may be influenced by bodily states of deprivation, incentives, fatigue, drugs, hormones, temperature, and emotions. Both ability (learning) and motivation are factors in performance and if either is absent, effective performance does not occur.
Cognitive Effects (COGNEFFS)	Ability to concentrate and attend to a task. Includes the short-term and long-term memory, retention, and recall of information.
Short-term Memory (SHTMEM)	This term refers to the retention of "new" information over brief intervals of time, for example, up to one minute. Short-term memory has a small capacity (about seven items) and holds material in a relatively less-processed form than long-term memory. The term also applies to a "working" or operational memory that maintains information temporarily activated from long-term memory in the process of solving a particular problem. For example, in adding up the digits of a memorized phone number, it is necessary to keep the digits (and partial sums) available during the course of computing the sum.
Long-term Memory (LGRMEM)	A memory system that keeps information for long periods of time, has a very large capacity, and stores information in a relatively processed form. Long-term memory refers to the relatively permanent component for the human memory system.
Retention (RETENT)	The conservation over time of previously learned or acquired information. Retention of information over time is the inverse of forgetting.
Retrieval (RETRIV)	
Storage (STORAG)	The acquisition of information. The learning stage (as opposed to retention and retrieval) of memorizing in which new information is incorporated into long-term memory.
Concentration (CONCEN)	The ability to sustain attention on a specific task or input channel. Sustained concentration is the ability to maintain a given level of alertness over a long period of time. Concentration is affected by the length of time in a supervisory task, stress, sleep loss, temperature, humidity, and noise.
Attention (ATTENT)	The process of determining which of many concurrent stimuli will be analyzed and reacted to. Attention refers to the focusing and sequencing of a limited information processing capacity.
Reasoning (REASON)	

Communication (COMMICAT)	Ability to understand and respond to speech for relating ideas necessary for task completion.
Speech Understanding (SPUNDS)	The ability to comprehend human speech. Methods for measuring the efficiency of speech communication are usually obtained by articulation testing procedures. In articulation testing, a speaker reads standardized lists of syllables, words, and sentences to a group of listeners and the percentage of items correctly recorded by these listeners yields an articulation score.
Signal-to-Noise Ratio (SIG2NR)	
Frequency Content (FRQCNT)	
Speech Intelligibility (SPEECH)	
Response Process (RESPRC)	The efficiency and speed of a listener in responding to speech. Listeners greatly improve with practice in understanding distorted speech or speech heard in the presence of noise. However, there are large individual differences in response to distorted speech.
Dexterity (DEXTERIT)	Fine motor response, fine motor manipulation, and fine motor strength.
Fine Motor Manipulation (FMMANP)	Motor coordination usually involves small movements which require extensive precision or speed (or both). Rather than strength, precision of movement is stressed in fine motor tasks.
Fine Motor Response (FMRESP)	Motor response where the factor of strength is secondary to speed or precision or both. Activity concentrated in the limbs or small musculature such as fingers, as opposed to large musculature such as the trunk or torso. In fine motor response (e.g., typing), timing and precision of movement are emphasized.
Fine Motor Strength (FMSTRG)	Strength concentrated in limbs and other small musculature required for precise movements.